HAZARDOUS AEROSPACE MATERIAL MISHAP EMERGENCY RESPONSE (HAMMER)

Sources of Exposure

- Gases, vapors, and particulate matter
- Polycyclic aromatic hydrocarbons (naphthalene), nitrogen-containing aromatics (aniline), and phenol-based organic compounds have been detected during studies of composite material combustion byproducts.
- Radioactive Materials

Table 6. General Aircraft Mishap Related Hazardous Materials Concerns

Hazardous Material	Physical Description	Health Hazard	Aircraft	Quantity/Location
Hydrazine	Clear, oily, liquid with an odor similar to ammonia; combustible and explosive	Can cause severe local damage or burns with contact to skin and eyes. If inhaled, vapor causes local irritation to eyes and respiratory tract and systemic effects	F-16	6.8 gallons
Beryllinm	Dust or powder form silvery and resembling aluminum powder	Toxic respiratory and eye irritant; if introduced under skins through cuts or punctures, slow-healing ulcers may develop	C-5, F-100, A-7D	C-5 Brake pads, F-100 wingtip area and around cockpit; and the A-7D landing gear bushings
Triethyl-borane	Extremely toxic and volatile liquid with a sweet pungent odor	Contact with skin or eyes will cause deep thermal burns	SR-71	700cc, Upper left side of each engine
Lithium Thionyl Chloride	Soft, silvery highly reactive metallic element	Reacts violently with H2O, serious injury to personnel can occur if incorrect fire suppression procedures are ignored	C-17	Used in on-board computer batteries
Pressurized tanks/acft parts	Compressed liquids and gases (oxygen), tires	Physical/chemical hazards from projectiles, release of materials	All	Interior/exterior
Strontium	Radioactive material used in aircraft construction	Internal and external hazard; Beta radiation dose reduce 10% by wearing leather gloves	Helicopters	Anti-ice detectors and blade integrity indicators
Depleted Uranium (DU)	Radioactive heavy metal used as a ballast or counterweights in aircraft gyroscopes, flight controls, helicopter blades, and aileron balances; chemical and radiation hazard	Inhalation is the most significant mode of entry; If involved in fire, DU will release very toxic fumes depositing in the respiratory tract then taken into the blood stream and deposited in internal organs. This allows intense ionization by the alpha particles resulting in severe localized damage to cells.	A-7	2 weights, One in cockpit and one in lower part of vertical stabilized
			A-10	30mm Ammo
			C-5	One on left and right ailerons and five on left and right elevators
			C-130	Ailerons, elevators, ad rudder
			C-141	Left and right ailerons 46 weights on left and right elevators
			F-16	Gun pods on certain models
			KC-10	Ailerons, elevators, ad rudder

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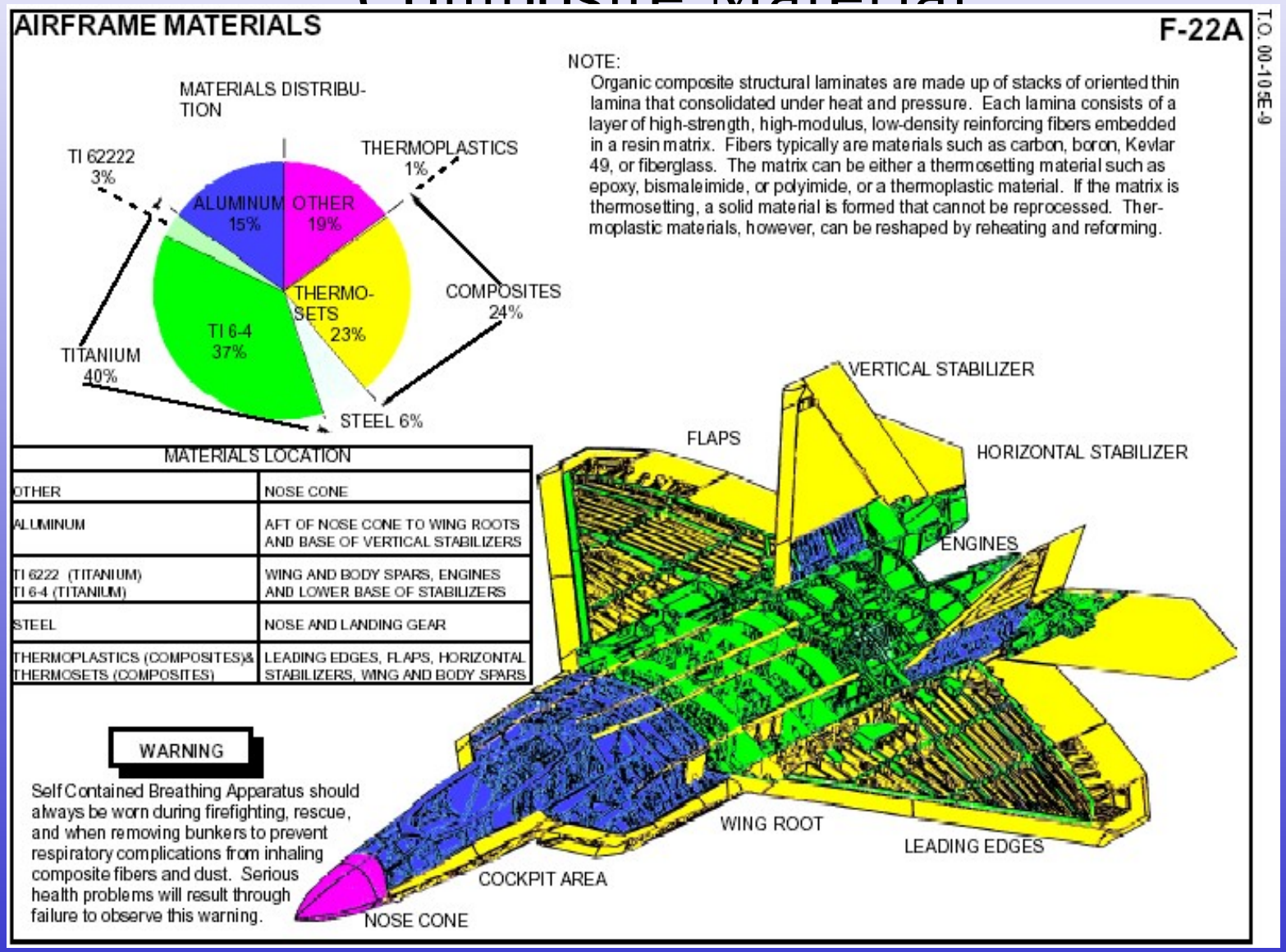
Known Mishap-Related Injuries

Symptom	Associated Aircraft	Composite Type
Reduced exercise capacity	F-18	Graphite-epoxy
Sore throat, eyes, chest, and skin	Harrier GR5	Graphite-epoxy Graphite-BMI
Dermatitis on arms	AV-8B	Graphite-epoxy
Headache, vomiting, trouble breathing	AH-64	Graphite-epoxy Kevlar-epoxy
Breathing problems, nausea, headache	F-117	Graphite-PEEK Glass-epoxy

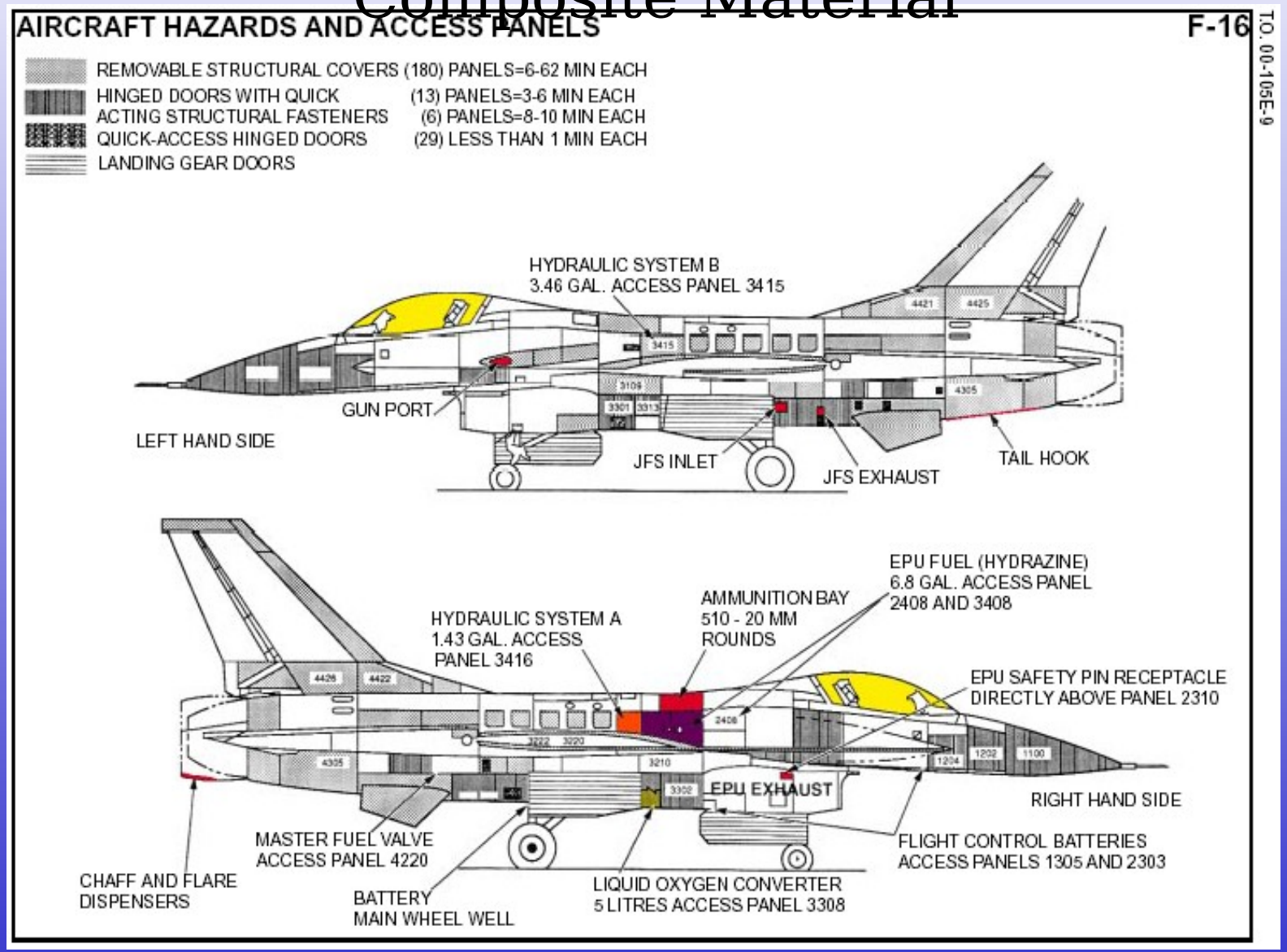
Table 1. Dust Task and TWA Exposure Concentrations During Recovery Operations

Aircraft	Crash Date	Fiber Type	Operation	Sample Type	Dust (mg/m^3)	
					Task	8-hr. TWA
F/A-18	1989	Graphite	Heavy equipment operator	total dust	NA	15.9-18.3
			Mishap Investigators		NA	24.1
F-14	1986	Boron	Crash pit work	total dust	2.5-4.3	0.318-0.636
F-16	1999	Graphite	Spraying, pick-up, wrapping	Inhalable	0.046-1.324	<1
				respirable	0.053-0.785	<1
F-16	1998	Graphite	Spraying, pick-up, wrapping	inhalable	0.450-2.61	<1-1.7
				respirable	0.23-0.695	<1
F-16	1998	Graphite	Spraying, pick-up, wrapping	inhalable	0.059-1.11	<1
				respirable	0.012-0.36	<1
F-16	1999	Graphite	Spraying, pick-up, wrapping	inhalable	0.89-19.2	<1-1.01
				respirable	0.08-5.73	<1
A-10 wing (crash simulation)	2000	Graphite	Simulated recovery, clean-up, cutting, wrapping	respirable	0.0004-0.001	0.0001-0.0003
				total dust	0.003-0.004	0.001-0.0012

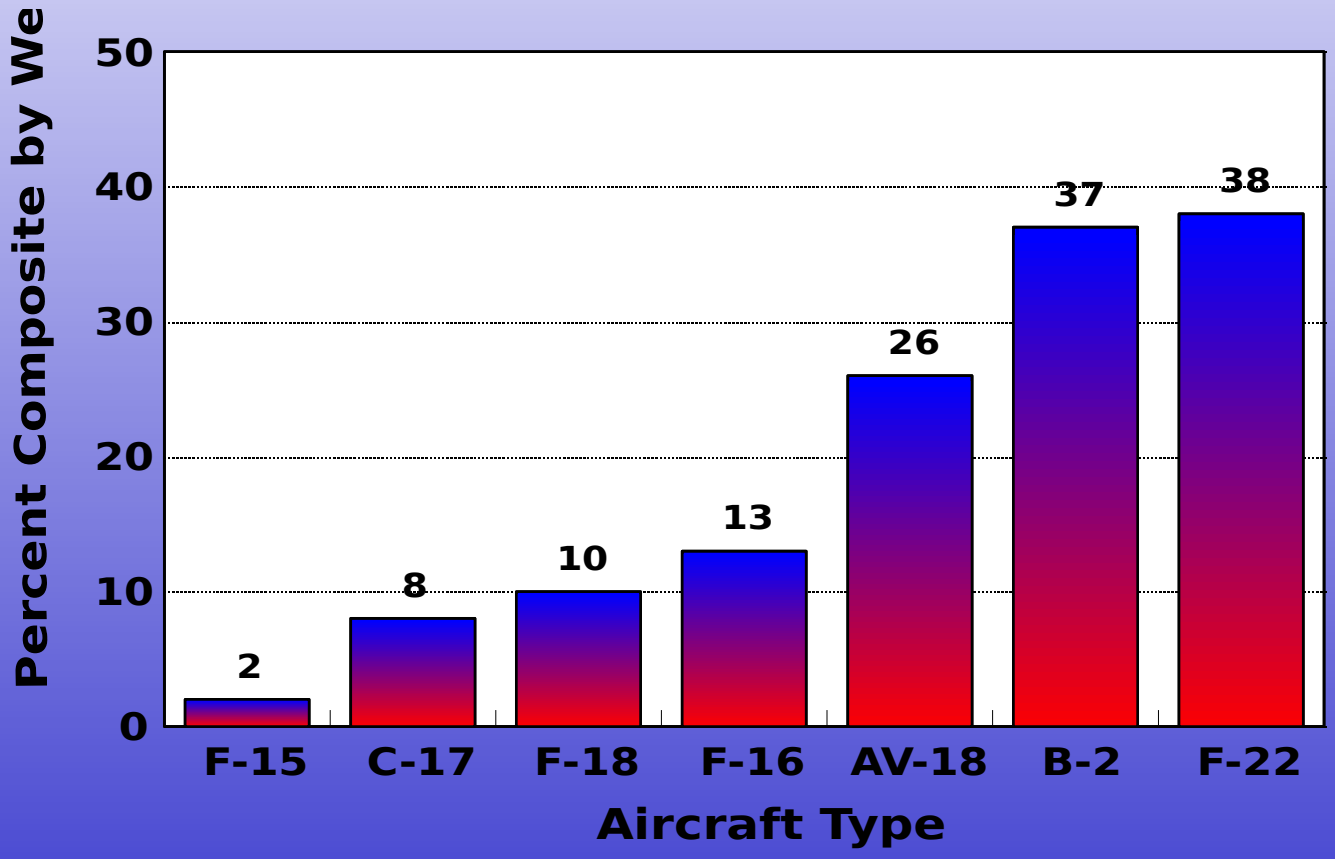
Aircraft Type/Quantity of Composite Material Identification and Location of Composite Material


AIRFRAME MATERIALS
F-22A
T.O. 00-105E-9
NOTE:
Organic composite structural laminates are made up of stacks of oriented thin lamina that consolidated under heat and pressure. Each lamina consists of a layer of high-strength, high-modulus, low-density reinforcing fibers embedded in a resin matrix. Fibers typically are materials such as carbon, boron, Kevlar 49, or fiberglass. The matrix can be either a thermosetting material such as epoxy, bismaleimide, or polyimide, or a thermoplastic material. If the matrix is thermosetting, a solid material is formed that cannot be reprocessed. Thermoplastic materials, however, can be reshaped by reheating and reforming.
MATERIALS DISTRIBUTION
TI 62222 3%
THERMOPLASTICS 1%
ALUMINUM 15%
OTHER 19%
THERMO-SETS 23%
COMPOSITES 24%
TI 6-4 37%
TITANIUM 40%
STEEL 6%
MATERIALS LOCATION
OTHER
NOSE CONE
ALUMINUM
AFT OF NOSE CONE TO WING ROOTS AND BASE OF VERTICAL STABILIZERS
TI 6222 (TITANIUM)
TI 6-4 (TITANIUM)
WING AND BODY SPARS, ENGINES AND LOWER BASE OF STABILIZERS
STEEL
NOSE AND LANDING GEAR
THERMOPLASTICS (COMPOSITES)& THERMOSETS (COMPOSITES)
LEADING EDGES, FLAPS, HORIZONTAL STABILIZERS, WING AND BODY SPARS
WARNING
Self Contained Breathing Apparatus should always be worn during firefighting, rescue, and when removing bunkers to prevent respiratory complications from inhaling composite fibers and dust. Serious health problems will result through failure to observe this warning.
VERTICAL STABILIZER
FLAPS
HORIZONTAL STABILIZER
ENGINES
WING ROOT
LEADING EDGES
COCKPIT AREA
NOSE CONE

Aircraft Type/Quantity of Hazardous Material Identification and Location of Composite Material



Composites on Aircraft



APPENDIX A

Aircraft Composite Material Locations (known locations as of 10 Sep 98)

Aircraft	Location	Composite Fiber/Matrix *				
		B/EP	GL/EP	AR/EP	GR/EP	GR/BMI
A-10	Leading Edges			x	x	
AV-8	Flap					x
	Gunpack					x
	Horizontal Stabs				x	
	Nosecone				x	
	Rudder				x	
	Wing Skin				x	
B-1	Ailerons				x	
	Fairings				x	
	Longeron	x				
	Weapons Bay Doors				x	
B-2	Control Surfaces				x	
	Ducting				x	
	Leading Edges				x	
	Trailing Edges				x	
	Wing Skins/Substructure				x	
C-5	Radome		x			
C-17	Ailerons				x	
	Fillets				x	
	Landing Gear Doors				x	
	Leading Edges				x	
	Nacelle Doors				x	
	Radome		x			
	Rudders				x	
	Spoilers				x	
	Stabilizer				x	
	Trailing Edges				x	
	Wing Fuselage				x	
	Wing Trailing Edges				x	
	Winglets				x	
C-130	Radome		x			
C-141	Radome		x			
	Wing Substructure	x				

*B/EP = Boron/Epoxy
GL/EP = Fiberglass/Epoxy
AR/EP = Aramid/Epoxy
GR/EP = Graphite/Epoxy
GR/BMI = Graphite/Bismaleimide

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Aircraft	Location	Composite Fiber/Matrix				
		B/EP	GL/EP	AR/EP	GR/EP	GR/BMI
F-14	Horizontal Stabilizer	x				
	Vertical Stabilizer	x				
F-15	Horizontal Stabilizer	x				
	Speed Brake				x	
	Vertical Stabilizer	x				
F-16	Horizontal Stabilizer				x	
	Vertical Stabilizer				x	
F-18	Dorsal Covers				x	
	Horizontal Stabilizer				x	
	Vertical Stabilizer				x	
	Wing Skin				x	
F-22	Edges		x			x
	Outer Skin					x
F-117	Edges		x			x
	Rudders				x	
	Weapons Bay Door				x	
HH-60	Cockpit Surface			x		
	Main body				x	
	Rotor Blades					
KC-10	Radome		x			
KC-135	Radome		x			
T-3	Cockpit Surface				x	
	Surface/Substructure		x			
V-22	Wetted Surface				x	

*B/EP = Boron/Epoxy
GL/EP = Fiberglass/Epoxy
AR/EP = Aramid/Epoxy
GR/EP = Graphite/Epoxy
GR/BMI = Graphite/Bismaleimide

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Reducing Risk at the Crash Site

- Anticipation
  - becoming familiar with TO 00-105E-9
  - training-developing response checklists
- Recognition
  - damage assessment
  - communication with maintenance personnel
- Control
  - Applying fixant to reduce fiber/dust exposures
  - PPE

Table 3. Follow On Response

Specialty	Activity/Task	Personal Protective Equipment							
		Low Risk				High Risk			
		Coveralls	Gloves[1]	Eyes	Respirator	Coveralls	Gloves[1]	Eyes	Respirator
Composite Fiber or Crash Recovery Team	1. Risk Assessment -spray fixant -wrap material	X	X		(Assume high) FF APR	X	X		FF APR
BEE	1. Risk assessment	X	X		(Assume high) FF APR	X	X		FF APR
	2. Sampling		X		None	X	X		
Initial/Permanent Safety Inspection Board	1. Preserve Evidence 2. Identify & tag parts -light movement		X		None	X	X		Dust mask (FFPD)
Aircraft Recovery	1. Package/Remove aircraft -light handling		X		None	X	X		Dust mask (FFPD)
	2. Aggressive handling (sawing, shredding)	X	X		FF APR (for eye protection)	X	X		FF APR

X- indicates PPE required

1- Leather outer gloves, nitrile rubber inner glove

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Resources

- AFIERA HAMMER Program Website

https://www.afms.mil/afiera/rsh/IndustrialHygiene/hammer.html

- T.O. 00-105E-9

http://137.244.215.33/ti/tilta/documents/to00-105E-9.htm

- Aircraft Radioactive Material Database

Point of Contact

Industrial Hygiene Flight

DSN 240-6137

Commercial 210-536-6137

ihbranch@brooks.af.mil

https://www.afms.mil/afiera/rsh/IndustrialHygiene/index.html